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JOURNAL

OF THE

AMERICAN WELDING SOCIETY

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33 West Thirty-ninth Street, New York

American Welding Society

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JOURNAL
OF THE
AMERICAN WELDING SOCIETY

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AMERICAN WELDING SOCIETY
ESTABLISHED 1919
JOURNAL

Volume 2 • AUGUST, 1923 Number 8

TENATIVE PROGRAM
for
FALL MEETING
of the
American Welding Society
To Be Held
In PITTSBURGH
OCTOBER 24, 25 and 26, 1923

All Sessions Start Promptly as Scheduled

WEDNESDAY, OCTOBER 24, 1923

MORNING

9:30 a. m. to 12. Opening Session Third Fall Meeting

(a) Adress of Welcome—J. D. Conway, Chairman, Pittsburgh Sect.
(b) General Statement of Society's Affairs—T. F. Barton, President, A. W. S.
(c) General Discussion of the Following Subjects—
1. General Interest in Section Meetings
2. Journal
3. Membership
4. Promotion of Welding

AFTERNOON

2:00 p. m. to 5. Industrial Application Session

(a) Report on the Industrial Applications of Welding and Its Possibilities
(b) General Relations of Society to the Industry—T. F. Barton, President, A. W. S.
(c) Technical Work of Society—C. A. Adams, Director, American Bureau of Welding

EVENING

7:00 p. m. Fall Dinner of the American Welding Society

THURSDAY, OCTOBER 25th, 1923

MORNING

9:00 a. m. to 11:00 — **Electric Arc Welding Committee**
H. M. Hobart, Chairman

9:30 a. m. to 11:00 — **Executive Committee, A. W. S.**

11:00 a. m. to 12:30 — **Joint Session Board of Directors, A. W. S. and Executive Com. American Bureau of Welding**

AFTERNOON

2:00 p. m. — **Inspection Trip**

EVENING

8:00 p. m. — **Meeting with Pittsburgh Railway Club**

FRIDAY, OCTOBER 26th, 1923

MORNING

9:30 to 12:00 — **Gas Welding Committee**
S. W. Miller, Chairman

9:30 a. m. to 12 — **Joint Meeting Membership Committee and Vice-Presidents, American Welding Society**

AFTERNOON

2:00 p. m. to 5:00 — **Committee on Training of Operators**
J. C. Wright, Chairman

2:00 p. m. to 5:00 — **Inspection Trip**

8:00 p. m. — **Pittsburgh Section Meeting and American Welding Soc.**
(Subject to be announced later)

PREPARATIONS STARTED FOR ANNUAL FALL MEETING

The Annual Fall Meeting of the Society will be held in Pittsburgh from October 24 to 26th, 1923. A tentative program of the meeting is included elsewhere in this issue.

An unique feature of this meeting will be the Opening Session on Wednesday morning. President Barton will present a general statement of the Society's affairs and an opportunity will be provided to all the members to discuss the activities and policies of the Society. While a good part of the work must necessarily be done by a limited number of committee members, nevertheless, the advice and assistance of the entire membership is needed and wanted at all times. Discussion will be centered on four important topics, namely, the interest shown in Section meetings, the journal of the American Welding Society, ways and means of increasing membership and the general promotion of welding.

One of the principal sessions of the entire program is the industrial application session scheduled for Wednesday afternoon. All of us realize that there are a large number of industries who are familiar with welding in a very vague way through infrequent newspaper accounts. It is our duty to call to their attention the enormous possibilities of welding and the economies which result from its use. The Meetings and Papers Committee are preparing a comprehensive report on the industrial application of welding and the relation of the Society to the welding in-

dustry. There will be invited as guests representatives from all of the industries that should be interested in welding, living in Pittsburgh and its vicinity. Every member is requested to make a special effort to advertise this session and attend himself.

Our first three dinners were a success and the entire membership will be pleased to learn that another will be included on the program of the Fall meeting. Further details as to place, time and special features will be given later.

Following out the precedent established at the Fall Meeting, at which time a joint session was arranged with the American Electric Railway Association, an effort will be made to arrange a joint meeting with the Pittsburgh Railway Club which holds its meeting on the evening of October 25th. It is expected that the Society will be successful in this attempt and bring to the attention of another group the good work it is doing.

Entertainment and Educational features are also provided through two inspection trips. Although the details of these have not yet been arranged, the Meetings & Paper Committee wishes to take this occasion to assure the membership of the Society that they will be well worth while.

The technical part of the program has not been neglected as a joint session between the Pittsburgh Section and the American Welding Society has been arranged for Friday evening, October 26th. The subject and speaker will be announced later.

Our Society is in a stronger position than ever before not only from a financial viewpoint and increased membership, but also from the viewpoint of accomplishments. We are known and recognized throughout the world as the greatest authoritative body for the dissemination of reliable welding information. Our reports are accepted without question alike by industrialists and legislators.

Every effort should be made to make this Fall Meeting a success in order that it may reflect to the credit of the Society.

APPLICATION OF ARC WELDING TO SHIP CONSTRUCTION

Those who have been interested in the applications of welding in the above field have for a long time felt the need of a digest of the available literature and unpublished existing information. This need was recognized by the Electric Arc Welding Committee of the American Bureau of Welding and with its cooperation Mr. E. H. Ewertz, General Manager of the Moore Plant, Bethlehem Shipbuilding Corporation, has prepared such a review.

On account of its length and the large number of illustrations, it was impossible for the Society, for financial reasons, to publish the report itself. Arrangements were, therefore, made with *Marine Engineering* to publish it as a serial. After it is completed it is planned to have it reprinted in bulletin form and made available to our members.

The report includes a summary of the present applications of welding as compared with riveting; a description of the arc welded ships already in existence and their performance; a review of the repairs to the German liners and the results of tests in England and United States to demonstrate the adequacy of welding as applied to ship construction; a description of several designs of welded ships; a comparison of the advantages of welding versus riveting and finally a bibliography. It is needless to say it is the most complete summary available on this subject. It is prepared for the use of the ship designer, the draftsman and those interested in the applications of welding in this field.

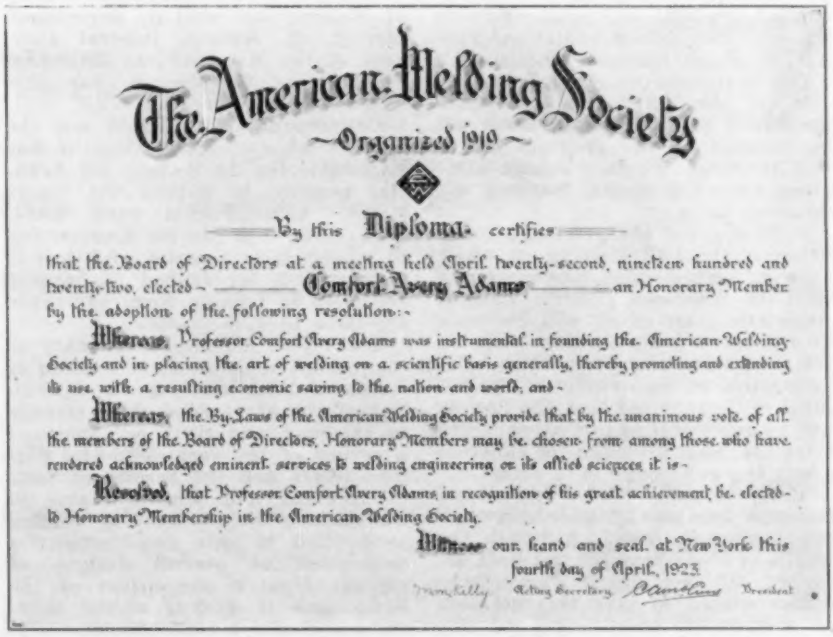
Publication of this report was started with the July Issue of Marine Engineering and will be continued monthly until its completion.

OUR HONORARY MEMBERS

Perhaps very few of our members realize that among its membership the American Welding Society includes some of the foremost scientists and leaders of industry in the world. It is partly through their help that we have been able to build up the American Welding Society to what it is today.

Occasionally through some honor which is bestowed upon them we are made aware of the fact that the American Welding Society includes in its roster these able men. Among these are listed our three honorary members—Professor C. A. Adams, founder of the American Welding Society and director of its Research

Department, Professor Elihu Thomson, the inventor of the Electric Resistance Welding Process and Mr. Edmund Fouche, of Paris, the inventor of the first Oxy-Acetylene blow pipe.



The American Welding Society

—Organized 1919—

By this Diploma certifies

that the Board of Directors at a meeting held April twenty-second, nineteen hundred and twenty-two, elected — Comfort Avery Adams — an Honorary Member by the adoption of the following resolution:—

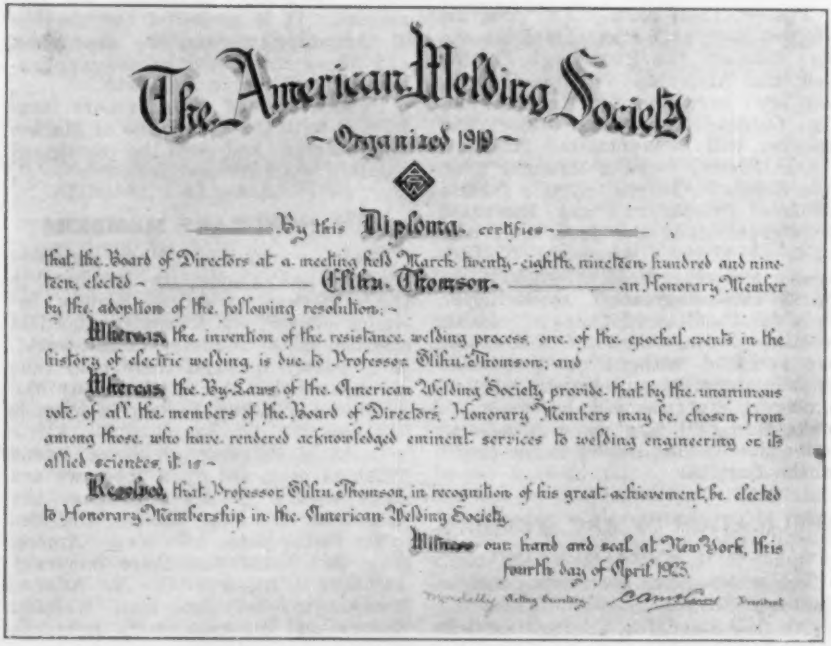
Whereas, Professor Comfort Avery Adams was instrumental in founding the American Welding Society and in placing the art of welding on a scientific basis generally, thereby promoting and extending its use with a resulting economic saving to the nation and world, and—

Whereas, the By-Laws of the American Welding Society provide that by the unanimous vote of all the members of the Board of Directors, Honorary Members may be chosen from among those who have rendered acknowledged eminent services to welding engineering or its allied sciences, it is—

Resolved, that Professor Comfort Avery Adams, in recognition of his great achievement, be elected to Honorary Membership in the American Welding Society.

Witness our hand and seal at New York this fourth day of April, 1923.

Acting Secretary — President



The American Welding Society

—Organized 1919—

By this Diploma certifies—

that the Board of Directors at a meeting held March twenty-eighth nineteen hundred and nineteen, elected — Elihu Thomson — an Honorary Member by the adoption of the following resolution:—

Whereas, the invention of the resistance welding process, one of the epochal events in the history of electric welding, is due to Professor Elihu Thomson; and

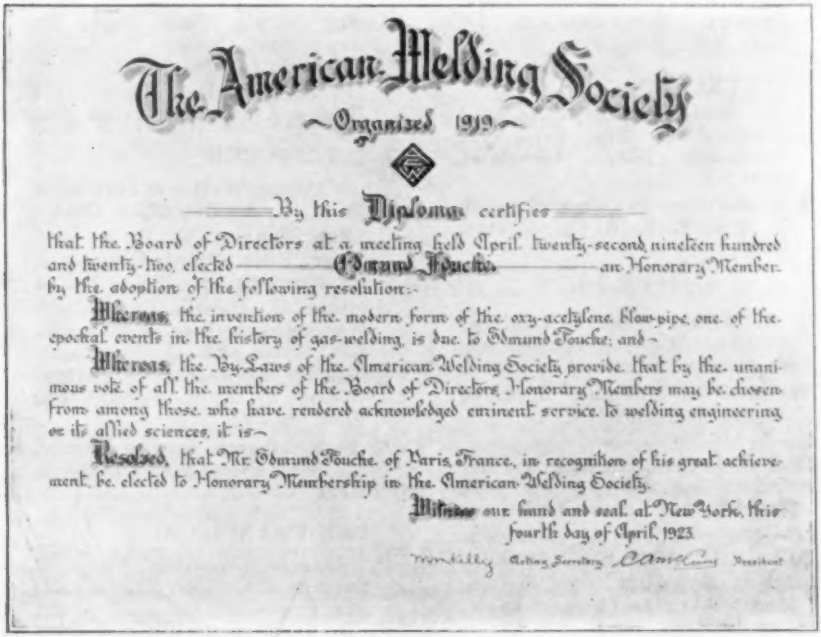
Whereas, the By-Laws of the American Welding Society provide that by the unanimous vote of all the members of the Board of Directors, Honorary Members may be chosen from among those who have rendered acknowledged eminent services to welding engineering or its allied sciences, it is—

Resolved, that Professor Elihu Thomson, in recognition of his great achievement, be elected to Honorary Membership in the American Welding Society.

Witness our hand and seal at New York, this fourth day of April 1923.

Acting Secretary — President

Photographs of the certificates of honorary membership are shown on the following pages. The art work was done by Mr. W. G. Steinmetz of New York, who is celebrated particularly for works of this character. The certificates have already been presented to Prof. Adams and Prof. Thomson. Due to the fact that Mr. Fouche is located abroad special arrangements are being made for a suitable presentation at Paris.



The American Welding Society

Organized 1919

By this Diploma certifies

that the Board of Directors at a meeting held April twenty-second nineteen hundred and twenty-two elected Edmund Fouché an Honorary Member by the adoption of the following resolution:-

Whereas, the invention of the modern form of the oxy-acetylene blow-pipe, one of the epochal events in the history of gas-welding, is due to Edmund Fouché; and -

Whereas, the By-Laws of the American Welding Society provide that by the unanimous vote of all the members of the Board of Directors, Honorary Members may be chosen from among those who have rendered acknowledged eminent service to welding engineering or its allied sciences, it is -

Resolved, that Mr. Edmund Fouché of Paris, France, in recognition of his great achievement, be elected to Honorary Membership in the American Welding Society.

Witness our hand and seal at New York, this fourth day of April, 1923.

Secretary Acting Secretary President

NEW MEMBERS FOR MONTHS OF APRIL, MAY and JUNE

BOSTON

	Class
George Jaeger, Sales Representative Air Reduction Sales Co., Dorchester, Mass.	B
P. E. Wilder, Gas & Apparatus Salesman Air Reduction Sales Co., Dorchester, Mass.	B

CHICAGO

J. P. Burns, Salesman, Air Reduction Sales Co., 2236 So. Lumber St., Chicago, Ill.	B
John T. Hume, Designer, Hurley Machine Co., 11017 Church St., Chicago, Ill.	B
R. O. Mueller, Salesman, Air Reduction Sales Co., 2236 So. Lumber St., Chicago, Ill.	B
S. H. Shaykin, Salesman, Air Reduction Sales Co., 2236 So. Lumber St., Chicago, Ill.	B
M. M. Weist, Salesman, Air Reduction Sales Co., 2236 So. Lumber St., Chicago, Ill.	B
H. Blumberg, Metallurgist, A. O. Smith Corp., Milwaukee, Wis.	C
Everett L. Cox, Operator, Central Steel & Wire Co., Chicago	C
Dr. Dale DeTrow, Wleding Instructor, The Oxweld RR. Service Co., 333 Railway Exchange Bldg., Chicago, Ill.	C
F. O. Ganvin, Acetylene & Elec. Arc Welder, Canadian National Rys., 199 Lingham Street, Ontario, Canada	C
Herbert S. Lansing, Welding Shop Prop., Lansing Welding Service, 310 So. Morgan St., Chicago, Ill.	C
Edward Riley, Elec. & Acetylene Welder, Albert Pick & Co., 1200 West 35th St., Chicago, Ill.	C

Henry Carlson, Welder, Enterprise Boiler & Tank Co., 1036 Orleans St., Chicago, Ill. ..... D

Victor Churchill, Welder, Mechanical Mfg. Co., 1245 West 63rd St., Chicago, Ill. ..... D

Gordon W. Parks, Elec. Welder, Chicago, Milwaukee & St. Paul RR., Milwaukee, Wis. ..... D

CLEVELAND

G. B. Close, Secretary The Ohio Chemical & Mfg. Co., 1177 Marquette Bldg., Cleveland, Ohio ..... B

S. J. Melville,, In chage of Weld. W. & L. E. R. R. Co., Canton, Ohio C

NEW YORK

L. H. Burkhart, Mech. Engineer Struthers-Wells Co., Warren, Pa. ..... B

Raymond S. Hoffman, Supt. of Shops, Standard Oil Co. (N. J.) Elizabeth, N. J. ..... B

Fred E. Rogers, Mech. Engr. Air Reduction Sales Co.,, 342 Madison Ave., New York ..... B

Leo Romney, Oxweld Acetylene Co., 30 E. 42nd St., New York B

Hugh G. Spilsbury, Pres. & Gen. Mngr. Alumino-Thermic Corp., Roselle Park, N. J. ..... B

Henry W. Carlson, Elec. Arc Welder, Hay Foundry & Iron Wks, Newark, N. J. ..... D

Roy J. Petty, 826 Columbus Ave., New York ..... D

NORTHERN NEW YORK

Robert Siemer, Pres. Allan Mfg. & Welding Co., Inc., Buffalo, N. Y. ..... B

J. Harry Baumer, Rochester Welding Wks., Rochester, N. Y. C

Alfonso B. West, Salesman Oxweld Acetylene Co., Delmar, New York C

M. Burkett, Elec. Welder, 621 Second St., Albany, N. Y. ..... D

Stanley P. Kerr, Mechanic Gen. Electric Co., Schenectady, N.Y. D

Thomas Middleton,, Elec. Welder General Electric Co., Schenectady, N. Y. ..... D

Howard C. Page, Elec. Welder, North Jackson, Ohio ..... D

Geo. Walter Phelp, Elec. Welder, Carmen, New York ..... D

Pestal A. Ramos, Elec. Welder, 135 Barrett St., Schenectady, N. Y. ..... D

Roy H. Togawa, General Electric Co., Schenectady, N. Y. ..... D

PHILADELPHIA

LeRoy Mihels, Shop Supt., International Boiler Co., East Stroudsburg, Pa. C

J. F. Rodgers, Gas Welder, 222 Bridge Ave., Phoenixville, Pa., D

PITTSBURGH

Dave Austin, Welder & Instructor Y. M. C. A., Columbus, Ohio ... B

J. Roy Tanner, V. P. & Gen. Mngr. Pitts. Valve, Foundry & Construction Co., Pitts., Pa. ..... B

Addison G. Bissell, Gen. Engr. Westinghouse Elec. & Mfg. Co., East Pitts., Pa. C

Russell W. Cochran, Elec. & Gas Welder, U. S. S. Vestal, New York, N. Y. ..... D

R. F. Helmkamp, Service Welder, 234 West Second St., Delphus, Ohio ..... D

SAN FRANCISCO

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F. R. Cook, Tank Builder Cook Oil Co., San Jose, Cal. ..... D

Jerry C. Downs, Elec. & Gas Welder, Santa Fe Ry. Co., Calwa, Cal. ..... D

Dave Gibson, Acetylene Welder Standard Oil Co., Richmond, Cal. ..... D

R. R. Roberson, General Welder Crocker Repair Shop, Daly City, Cal. ..... D

W. K. Russell, Acetylene Welder W. R. Ames Co., 450 Irwin St., San Francisco, Cal. ..... D

Frank T. Tanner, Welder W. I. Birtt, 75 Clew St., San Francisco, Cal. ..... D

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Jno. S. Beall, Pres. Coast Culvert & Flume Co., Portland, Oregon C

Ed. Black, Operating Welder The Weldmech Co., Hattiesburg, Miss. C

A. B. Phillips, Welding Supervisor Denver & Rio Grande RR., Salt Lake City, Utah C

R. Sarazin, Construction Engr., 48 Boulevard, D'Asnieres, Neuilly, France C

Chas. Wise, Foreman Welder A. T. and Santa Fe RR., Hopkins, Minn. C

John S. Adams, Elec. Welder, 873 5th Ave., Durango, Colorado ..... D

C. M. Johnson, Welder Gunn Rush Welding & Mfg. Co., 818 East 2nd St., Tulsa, Okla. ..... D

N. F. Morrow, Machinist Union Oil Co. of Cal., La Habra, Cal. D

Andrew L. Schaffer, Elec. Welder Empire Coal & Coke Co., Landgroff, W. Va. ..... D

George F. Scott, Salesman Scott-Foster & Co., 615 Hastings St., West, Vancouver, B. C. D

E. D. Tubbs, Elec. Welder, East Coast Boiler & Machine Co., Ft. Pierce, Fla. ..... D

Carl R. Wendler, Elec. Welder St. Joseph Ry. L. H. & P. Co., St. Joseph, Mo.

EMPLOYMENT SERVICE BULLETIN

Opportunities.—The Society is glad to learn of desirable opportunities from responsible sources, announcements of which will be published without charge in the Bulletin.

Services Available.—Under this heading brief announcements (not more than seventy-five words in length) will be published without charge to members. Announcements will not be repeated except upon request received after an interval of three months; during this period, names and records will remain in the office reference files.

Note.—Copy for publication in the BULLETIN should reach the Society's Office not later than the thirtieth of the month if publication in the following issue is desired. *ALL REPLIES should be Addressed to the Number Indicated in Each Case and Mailed to Society Headquarters.*

POSITIONS VACANT

V-12.—Need Supereintendent or Foreman of Electric Welding. Can always use some first class electric welders. Location Pennsylvania.

V-13.—Have an opening for a welder. Work Steady. Man expected at times to make guards and repair machinery. Must know how to weld by both gas and electric methods.

SERVICES AVAILABLE

A-19.—Want position in welding repair work. Have had about one year's experience in electric welding of tanks. Will go anywhere.

SPEED VERSUS GOOD WELDING

R. G. MASON*

The average man engaged in manufacture or repair shop work actually knows very little about practical welding. He has heard considerable of the remarkable results that may be obtained from oxy-acetylene welding, from gossip and very little reading. Unconsciously he acquires the notion that all such welding must be like that he has heard of, so when an emergency arises, he at once detemines to have his broken machine welded forgetting there are good welds and welds that are not good.

Broken machinery welded under *his* emergency directions breaks again and it is not unusual for him after such minor experience to thereafter condemn the principle of fusion welding.

The science of gas welding is in its early infancy, and although progress has been made the unknown fields for the application of welding are much greater than those already discovered. The old time method of welding iron and steel in the forge was a part of the blacksmith's trade, but today welding is a science—laws of chemistry, physics and metallurgy must be reckoned with if we are to progress. Of the other trades one stands out where science must be taken into consideration—that of the electrician, and in this case as also that of the art of welding, the workers must know why certain things happen and when this or that is done.

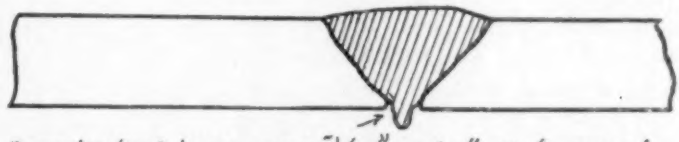
You would not consider for an instance the use of a sledge hammer to drive nails in a shingle roof, just to gain time by driving the nail with one blow of the hammer, yet very frequently just such a foolish thing is tried in the electrician's work and in welding. In a like manner the finished article may have a beautiful appearence yet laminations, "cold shuts," impurities, oxidized metal, poor penetration and other defects which are the causes of many failures may be covered up. Sometimes these things are done in ignorance on the part of the welder or it may be wilful negligence, and sometimes these conditions are forced upon the operator by those who are having the article welded, for it is generally accepted by the customers who are having some repairs made that the only thing to be kept in mind is "get the job finished," the sooner the better. This is especially true when the break has halted the trip of the passing motorist, stopped the factory or slowed down production. In certain emergencies it may be cheaper in the long run to make emergency repairs in order to keep up production or to maintain service. However, only in cases of the *rarest emergency* should excess speed be used when the job or repair is to be made by the welding process.

To bring this out more clearly the following illustration is given.

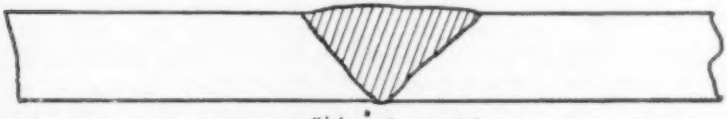
---

* Foreman Atchison Topeka & Santa Fe Railroad.

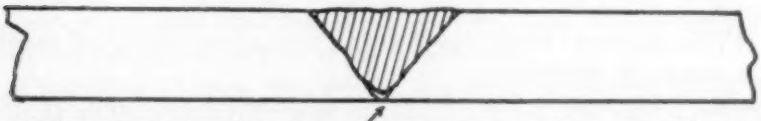
A manufacturing company had a break down on one of their important machines. To wait for new parts meant a delay of several weeks and would also necessitate the tearing down of the machine to install them. A friend of mine who owns a nearby welding shop was called in and imperative orders were given to have the machines running by the next morning no matter what the cost. The manufacturer with the amateurish idea supposed that any weld was a perfect weld. Speed was the paramount issue. Under such orders as this the welding foreman was obliged to put extra men on the work and several other unnecessary machines



Excessive heat burns away "Vee" and allows too much filler metal to run through.



Correct heat allows "Vee" to hold up and at same time permits good penetration



Not enough heat — lack of proper penetration

and tanks were hauled around as is done in most cases when time is to be reckoned with. To accomplish this job, under these conditions and make the job look like a good piece of work required the time of the foreman, two welders and four helpers, 6½ hours each, 12 lbs. of filler rod and 975 cu. ft. of gases. The job lasted three days. The parts were again welded this time the manufacturer *consented to follow the welding foreman's advice*, which was to strip the machine of certain parts so the welders could work in a free position and take their time. The foreman left the job this time to the two welders and two helpers which they did in 9 hrs, using 10 lbs of filler rods and 800 cu. ft. of gases.

Under these proper conditions the weld was a good weld. The machine is now in first class condition. The manufacturer by having his own way the first time lost two days time and the expense was double.

It can readily be seen that there were several other savings besides the time for while the first job was accomplished in 2½ hrs

less time a considerable more amount of both rods and gases were used and more labor was required.

There are of course several plausible reasons why a weld fails, such as, what caused the break in the first place, ignorance on part of the welder, impure material, improper preparation or too much speed or heat.

This article deals with the last named cause and many hours of grief as well as dollars can be saved if one will accept the experience of others.

Let us assume that in the manufacture of a certain article by welding the operator is urged to hurry up as is generally the case. Naturally it requires more heat to melt and fuse the material in a shorter space of time. The welder must put a larger nozzle on his torch, which gives a larger volume of heat, but incidentally also the blast or force is greater, another wrong condition. Too much heat causes failure just as not enough heat will make a poor job. Too much heat is a waste of both oxygen and acetylene. It also causes the operator unnecessary discomfort, (this condition alone will cause failure).

Second, excess heat, will vaporize the molten metal causing a waste of filler rods (more money thrown away).

Third, some of the elements are burnt out leaving weak oxidized metal, and failure is bound to occur.

Fourth, the molten metal will become more fluid and will splash over on a cold surface, causing adhesion instead of the proper cohesion.

Fifth, it breaks down the "Vee" in such a way that good penetration cannot be obtained.

These are only a few of the troubles resulting from trying to push a job beyond its limits and using an excess of heat to do the same. These faults can be seen plainly by the customer if he will have a few test pieces made for his benefit.

It is a known fact that a better weld can be made in less time and with less filler rod with the proper amount of heat than when we look only to the speed of the finished article. Moreover when the correct heat and size of filler rod is used there is no question of success.

WELDING OVER-HEAD WITH THE OXY-ACETYLENE FLAME

C. J. NYQUIST†

The applications of Oxy-Acetylene welding are now so varied and extensive that very few welders can rightfully claim to be expert in all of them. Nor is it to be expected that such a comparatively young industry as ours should have developed experts or so-called master welders. To be sure, there is a large number of very capable welders, some experienced in repair work, others skilled in sheet metal and steel plate welding, while there are many welders whose experience has been limited only to welding operations on specialties or often to only the welding of non-ferrous metals.

With all due consideration to the skill and dexterity desirable in all welding, it is the writer's opinion that certain classes of steel welding demand more real welding ability and personal dependability than any other class of metal welding. All other factors being equal, it is still evident that uniformly successful welding results on boilers and pressure vessels depend on the welder as well as on proper materials and design. The hazzards involved, if for no other reason, are sufficient to justify a careful selection of men for this class of work both with regards to personal responsibility as well as thorough knowledge of steel welding. The ability to execute sound over-head welds is one of the tests which might well be demanded of welders on work of this kind.

Over-head welding on steel or the welding on the under side of steel plate or other articles of steel requires thorough knowledge of proper heat distribution and the homogenous spread of the welding material. Practice may enable the welder to make the material stick in place, more or less loosely adhering to the base metal, but sound over-head welding simply can not be done unless the heat of the flame and every particle of the added metal are distributed in just the right way. The injurious so-called pool welding of steel is of course impossible in over-head welding on account of the position of the work. Utmost care must be used in the handling of the welding rod. If just the right heat is applied to it, welding overhead can easily be done without loss of the material.

A discussion with steel welders who have practiced over-head welding is quite illuminating. Some declare that a very stiff flame facilitates the welding over-head while other welders make special claims for certain choice welding rods, and some others rely on a more or less fancy manipulation of the torch. Good welding ma-

†Cabric Mfg. Co., Duluth.

terial is certainly always desirable, but high gas pressures are neither necessary nor conducive to good results. The idea that the molten material must be blown on or driven onto the base metal by force is quite erroneous, in fact, much better welding on steel, over-head or otherwise, is done with what is generally termed a soft welding flame.

In this connection reference to surface tension or the tendency of substances in liquid state to take a spherical form might be of value, but as this article is itended both for welders who may or who may not wish for the technical explanation, I believe that a less pretentious illustration or comparison will convey this information. For practical purposes this comparison may be termed, a similarity of heat conditions. Everybody knows that a drop of water, on a hot object will not spread but will stand as a pearl or round pellet until diminished and finally disappearing as steam. On the other hand, a drop of water on a cold metal plate will readily spread out in a thin film. A drop of hot steel will retain its round shape when deposited on a cold steel plate but when the plate is heated to the same or very nearly the same temperature as that of the deposited metal the spread is readily accomplished. In other words, when the base metal is heated sufficiently the added material will spread without difficulty.

Experienced welders know that by increasing the heat in any direction the molten metal from the welding rod may be made to follow the flame. They also know, or should know, that so-called chasing or pushing of the weld metal or the attempt to force the molten or nearly molten weld metal forward results in overlapping and consequently in poor welds. While it is self-evident that the metal cannot for obvious reasons be heated to a liquid state when welding over-head, it is equally true that overheating of the weld metal (the added material) in all steel welding is responsible for many failures.

Successful over-head welding most certainly demands considerable practice, steady hands and the will to overcome difficulties but even more important than these is the proper application of the first principles of Oxy-Acetylene welding—simultaneous and uniform fusion of the base metal and the weld metal.

THE APPLICATION OF ELECTRIC WELDING TO LARGE TANK CONSTRUCTION*

E. J. RIGBY†

Works of considerable interest to engineers have recently been carried out in connection with the undertaking of the Melbourne and Metropolitan Gas Co., and the methods adopted in repairing

* Taken from data furnished by Mr. Rigby and an article appearing in the April 26, 1923 issue "Industrial Australian and Mining Standard".

† Manager, Robert Bryce & Co., Pty Ltd.

and constructing some of the company's gas holders call for particular mention.

The following is a brief description of the methods employed in—

(1) Rebuilding a two-lift gasholder 150ft. diameter.
(2) Rebuilding and enlarging a two-lift 150ft. diameter gasholder to a three-lift gasholder, the inner lift being a flying lift (Fitzroy No. 1).
(3) Rebuilding the South Melbourne gasholder, which collapsed.
(4) Complete welding of Fitzroy No. 3 holder.
(5) External reinforcement of crown of a 3,000,000 gasholder.
(6) Building concentration plant for ammoniacal liquor.
(7) Electrical welding of steel construction for Woodall-Duckham retort.
(8) Welded mains.

So satisfactory has the gas company's experience with this method of welding been, that every class of work is now being welded by the construction department, and the results show the welded work to be stronger than similar work carried out by riveting. The company now employs a staff of 20 men on welding work, and the cost of the work they carry out is said to be a mere fraction of what it would be if performed by means involving blacksmith and boiler-making operations.

The Metropolitan Gas Co. was faced with the fact that certain of their gasholders required rebuilding, and this work was undertaken by the company's own staff in the year 1915, when a two-lift gasholder 150ft. in diameter was rebuilt.

Following this a similar holder, known as West Melbourne No. 2, was rebuilt and enlarged to a three-lift gasholder, the inner lift being a flying lift.

The Fitzroy No. 1 gasholder is notable in that, as far as can be learned, it was the first gasholder completely built and erected by a gas company's own staff. In carrying out this work exigencies of the moment required that an old gasholder tank, 83ft. diameter x 20ft. deep, should be used. This old holder had a single lift, containing about 100,000 cubic feet. The old tank had a reinforced concrete extension wall built around it, and a three-lift holder with lifts 30ft. deep, containing nearly 500,000 cubic feet, was erected in 1919-20. The tank extension consists of a tapered reinforced concrete wall 10ft. 6in. high, 6in. thick at top and 9in. at the bottom. This wall is extended 10ft. 6in. below the ground line, completely encircling the upper portion of the original brick tank. It was carried to this depth as the boundary walls of the works are within six feet, at places, of the old tank, and the public foot walks are at a lower level than the yard. Owing to the dearth of materials, use had to be made of some old crown sheeting for this holder; but, immediately supplies could be obtained, a new crown was ordered.

NEW CROWN SHEETING WELDED IN POSITION WHILE HOLDER IN ACTION

In 1922, one of the most remarkable developments to date was the putting of this crown sheeting in place and welding it up completely while the holder was in action. This, of course, meant that the old crown had to be left in place, and after the new crown had been completed and gas was admitted between the two skins, no leakage was detected.

3,000,000 GASHOLDER AT SOUTH MELBOURNE

The next holder to be built under the programme of gasholder rebuilding was that known as No. 3 holder at Fitzroy, but just

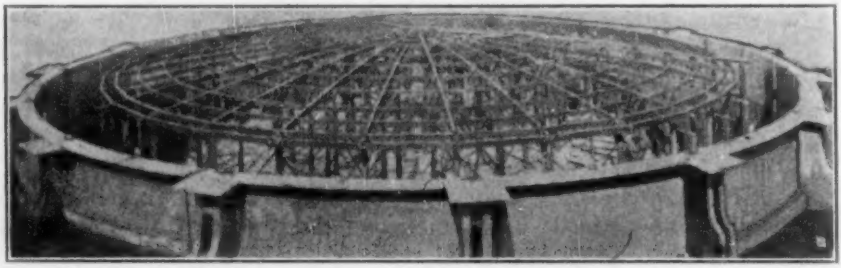


Fig. 1—New Tank and Framing prepared to receive the Holder. This view shows the centre of crown in position.

as the materials had been ordered, the three million gasholder at South Melbourne collapsed. This interfered with the programme of work, as the rebuilding of the South Melbourne holder had to be immediately taken in hand. It had to be completely replaced, as no portion of the floating bell, tank framing, etc., could be salved. Though the guide framing remained, a very great deal of this work had to be repaired and renewed. This new holder was originally re-designed on the lines of the ordinary riveted structure, but later it was decided to adopt electric welding. The holder was accordingly re-designed, and was afterwards completely welded up, except for the cups, dips and curbs, which were riveted, completing the first electrically-welded gasholder in the world.

About 600 tons of material were used in its construction, and on testing only six small leaks were discovered in the whole of the welding.

NO. 3 FITZROY GASHOLDER—FLOATING BELL AND GUIDE FRAMING ELECTRICALLY WELDED

This work finished, attention was then given to the No. 3 holder at Fitzroy, and in the light of the great experience gained, this holder was completely re-designed with the view of eliminat-

ing riveting altogether, both in the floating bell and the guide framing.

It was very early found that, though the ultimate result was the same whatever method of manufacture was adopted, all the old traditional methods of fabrication had to go by the board when welding was used. However, during construction, the saving was manifested the whole time, marking-off was greatly reduced, and punching and drilling were almost eliminated except for tacking and location holes. The cup and dip joints, always a costly item, were made at a fraction of the old cost and the results were immeasurably superior. It was found that everything could be made on jigs—simplifying assembly—and ensuring absolute similarity of all parts.

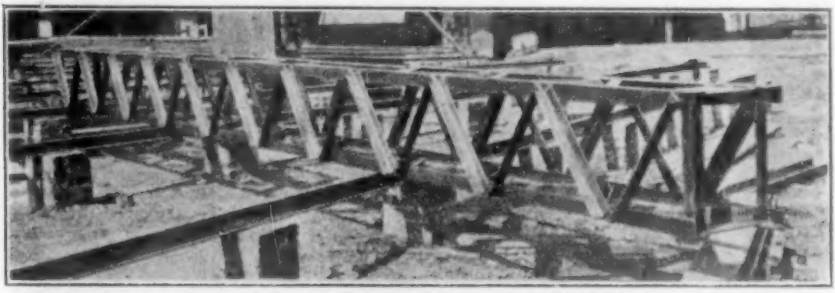


Fig. 2—Detail of a Horizontal Strut.

This gasholder was built to take the place of an old gasholder put in some 60 years before. This was a single-lift holder contained in a cemented brick tank 163ft. diameter by 25ft. deep, and had a capacity of half a million cubic feet of gas.

The new gasholder which takes its place in the same tank has nearly six times this holding capacity, or 2¾ million cubic feet.

To contain the new holder, the tank had a reinforced concrete extension built on to it, making its depth 36ft. 3in., and the dumpling or core was cut back and concreted, to accommodate the four lifts of the new holder, and the timber framework of the new design.

There are 16 guide standards sorrounding the floating bell, each made in five sections 28ft. long reaching to a total height of 144ft. above the tank. These standards are formed of two heavy steel channel sections 10in. x 3½in. at front and back with 8in. x 6in. section struts and diagonal angle iron bracings. At the top end of each of the five sections of the standard provision is made for the attachment of horizontal struts, which are of box section formed of four angle irons with angle iron diagonal bracing as shown in Fig. 2. Each of the five bays so formed has diagonal bracing of flat bar steel, with right and left hand adjusting screws from the top of one section of the standard to the bottom of the adjoining one.

At the extreme top of each of the standards, wind tie brackets extend horizontally towards the centre for a length of 13ft. These are formed of 6in. x 5in. section steel joists, connected at their outer ends by 4in. x ½in. flat steel ties, and two diagonal bracing stays, each fitted with right and left hand adjusting screws.

All the outside standards and framing, as also all the vertical stays and guides in the interior of each of the four telescopic lifts of this holder, were assembled and completely welded up in the workshops and afterwards assembled in position with the fewest possible service bolts to locate the various parts, when they were finally welded together in position.

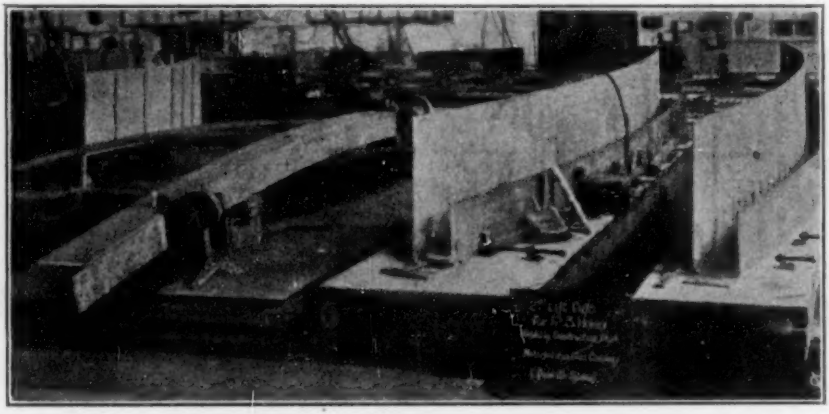


Fig. 3—View showing Assembly and Welding in the Workshop of Cups. Note the special Jigs for assembling the parts for welding.

The floating bell is constructed in four telescopic sections or lifts, each approximately 160ft. diameter and 35ft. deep, which rise to a total height of 140ft. when fully extended. The crown or roof of the inner lift is convex in shape, with a rise of 7ft. at the centre. Each of the lift sections is provided with the usual water seal, consisting of cup rings at the bottom and corresponding dip plate rings at their tops. These are formed of 12in. x 3½in. steel channels curved to radius, welded to 5-16in. thick dip and skirting plates. The intervening sheeting is all 9-64in. thick.

A general view of the assembly and welding of the cups in the workshop, with the special jig for assembling the parts for welding, is shown in Fig. 3. They are set up true and held in position with screws, as shown in the photograph, and strongly tack welded, then turned over to complete the welding in sections.

There are 16 vertical stays and guides in each of the four lift sections, formed of 9in. x 3in. steel channels with a 4in. x 2in. channel welded on each side flange for its whole length, in which the guide rollers, attached to the bottom of each cup section, run.

These stays are securely welded to the skirting plates at the top and bottom of each lift.

The inner lift has 32 vertical stays, constructed with brackets at the top end, which are connected by a ring of 12in. x 3½in. channel section, curved to suit the diameter, and welded to projecting ends of the brackets, to support the inner edge of curb plate, 9-16in. thick, which forms the outer ring of plates in the crown. The curb plate is welded at the outer edge to a 6in. x 6in. angle iron ring on the skirting plate at the top of the inner lift side sheeting.

On the top of each of the lift sections there are 16 carriages formed of 15in. x 5in. section joists, with angle brackets for holding down and carrying two adjustable face and side guide rollers which run in the front channel of the vertical standards.

The skirting plates which form the top and bottom of each lift section with the cups and dips of the water seal, were assembled in a special jig made to locate the parts in the workshop, and were welded up in convenient sections to handle, leaving only the joints where they are butted to be welded when in position. These sections were then placed in the concrete tank with the vertical stays in position and all the welding connecting them completed. The rest of the 9-64th side sheeting, with the usual lap joint, was then assembled to the top and bottom skirting plates, using widely spaced ¼in. service bolts in ⅜in. holes. The circumferential seams in each panel between the vertical stays were first welded to within a couple of inches of the vertical seams, beginning at the top and leaving the bottom seam unwelded. The vertical seams were next welded, and when these were done the corners of the intersecting sheets were welded, and finanlly the seam connecting the side sheets to the bottom skirting completed.

The laps of the sheets were fillet welded at the edges both inside and outside, and each lift was completely welded, before the assembly of the next one was commenced. Provision was made to counteract the contraction caused by the cooling of the welded seams, by wedging the sheeting out to a slightly greater diameter than the finished size, and welding all vertical seams in this position. On removal of the wedges the sheeting assumed the correct diameter. In welding up the crown sheeting similar provision was made.

Fig. 4 is from a photograph of the arrangement of wooden beams and wedges for distending the vertical seams to allow for contraction of the welds. The horizontal beams are suspended by ropes at regular intervals with their ends engaging the side channels welded on the vertical stays. Boards, 6in. x 1in., are then placed against the sheeting alongside each vertical seam and wedged outwards against these beams. As described previously, all the horizontal seams are then welded, commencing at the top, to within a couple of inchesof the vertical seams. The horizontal

seams are welded in panels covering two bays between the vertical stays, or one-eighth of the circumference.

Four welders are shown at work on the vertical seams and the space they cover represents what has been referred to as two bays or a panel; the same procedure is followed on the opposite side of the sheeting, simultaneously.

The total weight of steel in the structure is approximately 760 tons. Twenty men were employed for 16 weeks in the erection and welding of the four lifts, eight of whom were welders.

A revolving gantry crane for lifting the framing and material and placing it in position was designed and built at the works. The pivot was fixed on the centre of the crown, and the outer end of the gantry carrying the electrically-driven hoisting machinery,

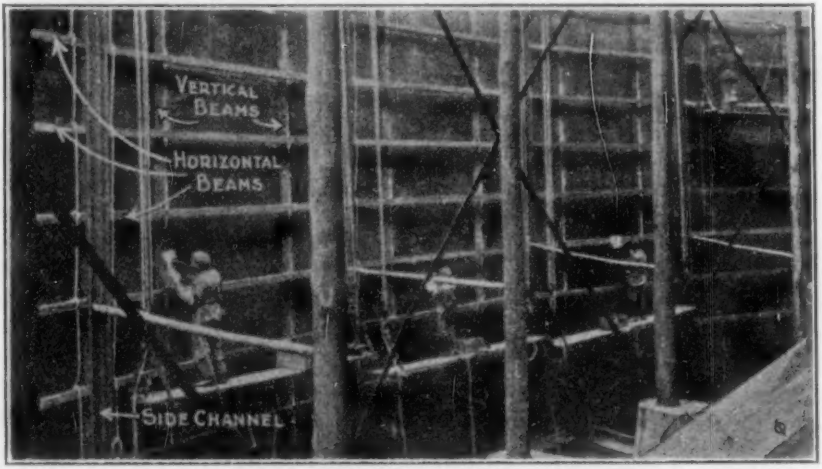


Fig. 4—Shows the arrangement of wooden beams and wedges for preventing buckling of plates during welding operations.

housing and jib, revolves on a steel rail mounted on sleepers carried by the wooden framing fixed inside the tank for supporting the crown when deflated. The jib is 100ft. long, made in three sections, and reaches, a height sufficient to place the topmost sections of the standards and bracing in position. All the joints and bracing of this steel jib and gantry were electrically welded, and the gantry is so designed that it can be easily dismantled and re-erected for building other gasholders of varying diameters.

CONCENTRATION PLANT FOR AMMONIACAL LIQUOR

The frame work of the concentration plant for ammoniacal liquor, which was electrically welded, is constructed of H and L Section bars throughout, and no assembly bolts or rivets were used in the construction of any part of it. The various members were cut cold, and, after being assembled in their permanent position, the various jointing ends were welded in place, including the ladder

ways and hand railings. This made possible the adoption of a simple way of building the ladders, which consists of 2in. x ⅜in. flat bars. The rungs are ⅝in. round bars merely laid on the edges of the flat bars and welded on both sides.

The various tanks have all their seams welded: the corners and tops and bottoms of both the square and round tanks were simply cut to size, butted together, tacked and welded. The end plates slightly overlap to permit of a fillet weld. The plate material is ⅛in. thick and the welds were all perfectly tight to ammonia gas. The large tank partly under the ground level was part of another portion of the gas plant, and is made of cast iron, and on this a ⅛in. sheet-steel cover was welded. This work is of special interest because the joint between the cast iron and the steel was rather a difficult piece of welding, and places had to be gone over several times before it was made perfectly gas tight.

External Reinforcement of the North Melbourne Gasholder Crown

After the collapse and explosion of the large gasholder at South Melbourne, caused primarily through a weakness in the crown due to internal corrosion in the sheets, it was proposed to strengthen the crown sheeting of other of the company's holders which had been many years in use.

The crown sheeting is really the most vital part of the whole structure, subjected as it is to variable stresses as the holder rises and falls and to vibration caused by variable wind pressures on the large unsupported area conducing to fatigue. After most careful investigation, Mr. J. N. Reeson, M.Inst.C.E., chief engineer of the company, originated and patended a method of external reinforcement, aptly described as a steel net or spider web, to be applied over the whole area of the crown. The net consists of a ⅜in. centre plate and four rings of 12in. x ⅝ flat steel bars, connected together by a series of radial bars of 3in. x ⅜in. flat steel. The bars comprising the several circular rings were bent to shape in convenient lengths. At each end of these lengths a butt strap, with the required overlap, was electrically welded on the top sides alternately, and two holes drilled by template for service bolts in the one end through the butt strap, and in the other connecting end through the main bar and welded butt strap. The straps are 1in. narrower than the bars to allow for a heavy fillet weld all round the butt strap. This work was all done on the ground, and after assembling them in place the alternate ends of the projecting butt straps were welded to the respective bars. The radial bars were then placed in position and their ends fillet welded to the rings and afterwards lowered into position to rest on the crown sheeting. It is worthy of note that the two holes drilled in the connecting ends of the ring bars were the only service bolt holes

used in the whole construction. The method of assembly and welding in position can be clearly followed from the accompanying photograph (Fig. 5), taken during progress of the work. In Fig. 5 the several arc welding outfits are shown standing on the centre plate of the net, with the welding cables leading therefrom to the several operators employed, and it is further worthy of note that the whole web was assembled, welded and adjusted in place with the gasholder in full service.

The free ends of the outer series of radial bars were finally welded to the crown curb.

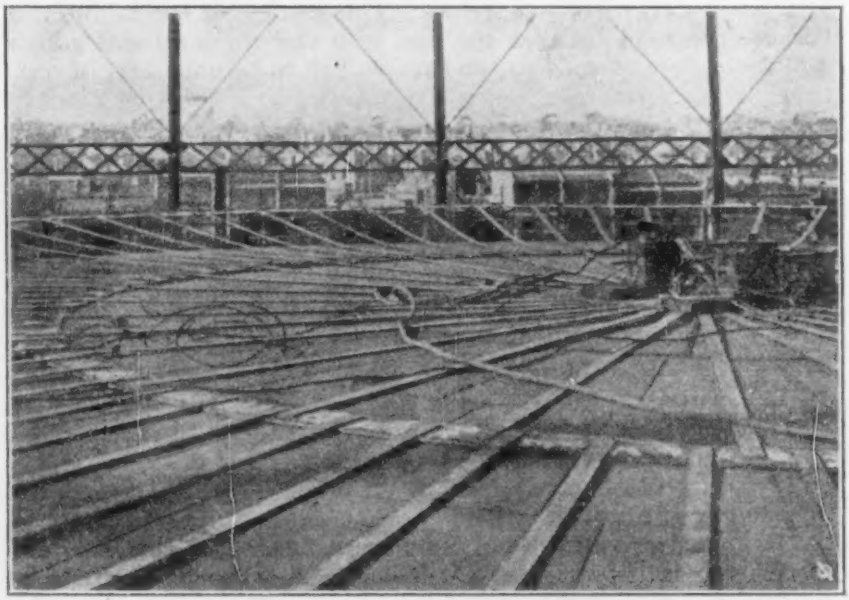


Fig. 5—External reinforcement of Gas-holder Crown.

The outer series of radial bars were made in two pieces, and each connected by two drawing screws at the centre of the bars, by means of which an accurate and equal measured strain was put into every radial member of the net.

On completion of the assembly of the net in position, the outer series of radial bars were each carefully "centre popped," by a special instrument, to make centre pops at 50in. centres; then a specially designed extensometer was used during the tightening up of the adjusting screws in each of the radials. At the completion of this adjustment the whole net was in its designed position and carrying the correct amount of tension.

This is the first example of the crown of a gasholder being so protected, and since the completion of the reinforcing of the North Melbourne holder a smaller holder has been similarly reinforced,

and the reinforcement for a third holder, 196ft. diameter, is now being prepared.

Steel Construction for Woodall-Duckham Retort House Electrically Welded

The Woodall-Duckham retort house, the steel construction of which was welded, has a capacity of 2,000,000 cubic feet of gas per day. The length of the building is 125ft., width 34ft., height 82ft. 3in. to eaves, the total weight of columns and girders, which are exceptionally heavy to enable them to carry the great weight of the banks of retorts, coal bunkers, etc., is approximately 375 tons.

All the structural work, built-up columns and girders and their connecting joints, including two steel chimneys each 100ft. high, 5ft. diameter, pipes, etc., have been electrically welded throughout, with only just sufficient assembly bolt holes to locate the parts in position for welding.

The construction generally is similar to that used for riveting, except that welding is employed in place of holing and rivets. All of the welding at the joints in assembly is done from a ladder or boatswain's chair to carry the welder as erection proceeds, in place of the usual planks and scaffolding to carry the riveting gang.

Water Tube Condenser for Cooling Two Million Cubic Feet of Gas Per Day

The external dimensions of the welded water tube condenser are:—Height, 21ft. 6in.; length, 10ft.; width, 4ft.

The condenser has five compartments fitted with 480 boiler tubes, each 1½in. diameter by 18ft. long, thus giving the gas 90ft. travel on its way through from inlet to outlet.

The condenser is proving very satisfactory and cooling in excess of its rated quantity.

Foul Gas and Blower Mains and Connections

The flanges of the welded steel gas and blower mains, from 12in. up to 30in. diameter, are all made of flat bar sections bent to shape to fit afound the pipes and welded back and front. All the joints of the pipes are butt welded without the use of holding bolts, assembling bolts or rivets, and they afford a good example of utility and economy of the welding plant. Usually such pipes and fittings would be made of cast iron with a great variety of expensive wooden patterns, and four or five times the weight to handle. In addition, they were all made and finished in less time that it would take to make the patterns.

In the case of 12in.pipes, 46ft. 6in. long, with 45 degrees set-off at each end, this was urgently required to connect up in connection with some reconstruction work. The pipe was constructed

and delivered within 24 hours after the dimensions reached the construction department.

All the apparatus described in this article was designed in the construction department of the Metropolitan Gas Co., Melbourne, under the supervision of Mr. J. N. Reeson, M.I.C.E., and his chief assistant, Mr. H. E. Grove, and was welded by the Quasi-arc process.

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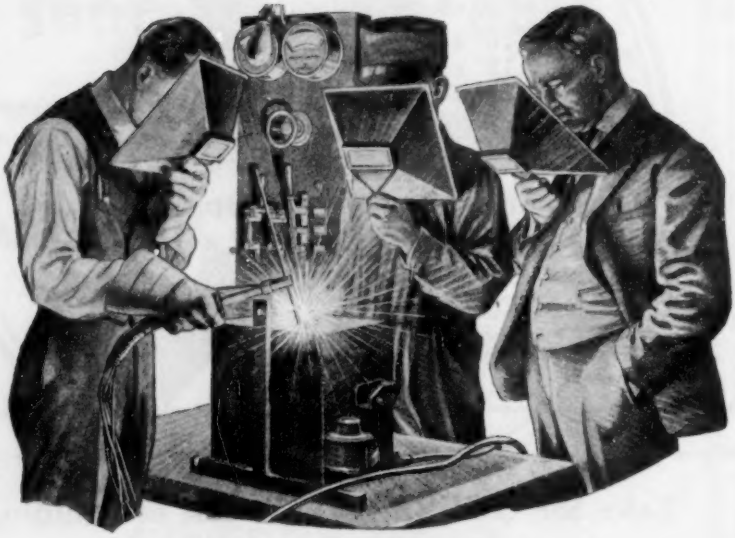

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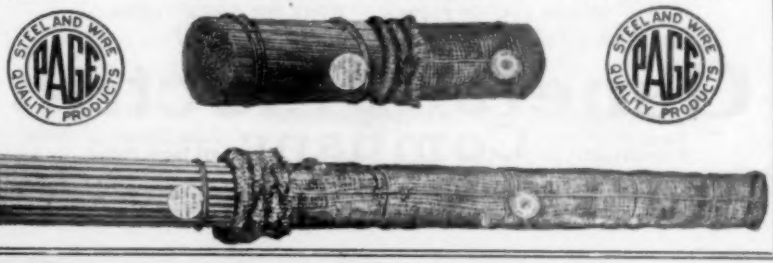

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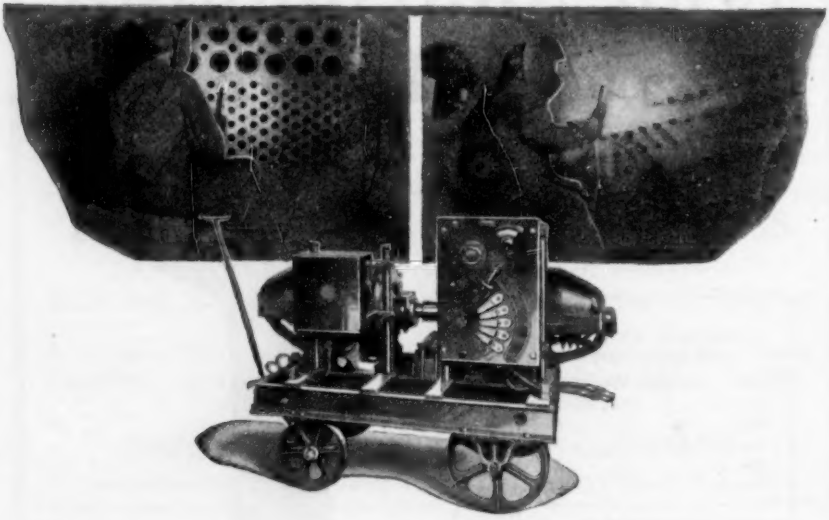

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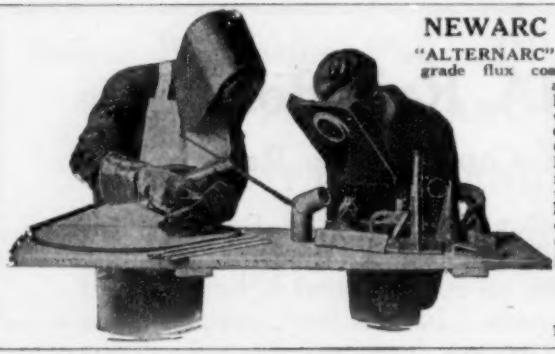

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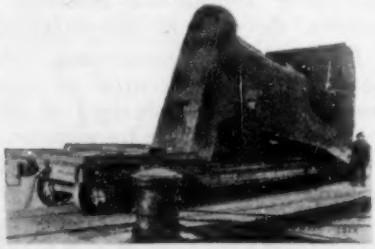

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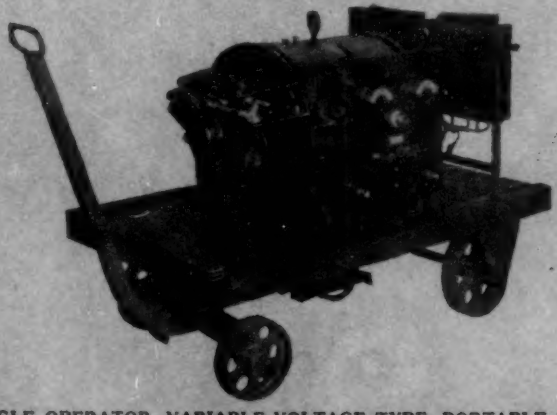

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